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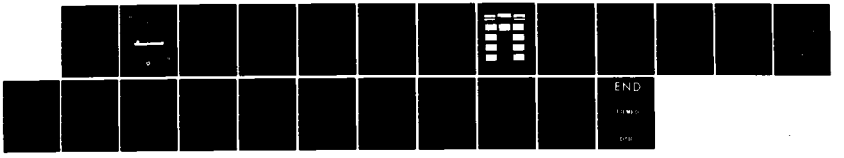

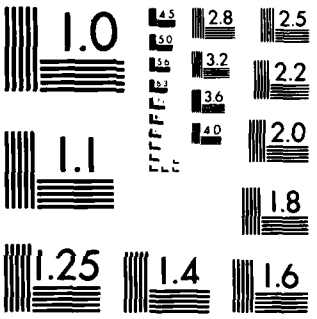

SHIPBOARD/SHORESIDE COMPUTER INFORMATION AND MANAGEMENT SYSTEM

PHASE II

EXECUTIVE SUMMARY

M.V. SUGAR ISLANDER

CONTRACT NO. DT-MA-91-82-C-20001
REPORT NO. MA-RD-770-84024
JULY 1984

U.S. Department of Transportation, Maritime Administration

Office of Advanced Ship Operation

LEGAL NOTICE

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16. Abstract (Limit: 200 words)

This is an executive summary on Contract No. DT-MA-91-82-C-20001 on the design, development and implementation of Phase II of a two-phase integrated shipboard/shoreside computer management information system. Phase II concerns Preventive Maintenance and Machinery History operating on shipboard/shoreside minicomputers. Phase I (Contract No. MA-80-SAC-01110) dealt with spare parts inventory control and ordering.

The design of the system was based on computerization of the existing Shipboard Maintenance and Repair System (SMARS-MARAD Contract No. 7-38014) which was implemented aboard the M/V SUGAR ISLANDER in 1977.

The present system utilizes a minicomputer aboard the ship and another minicomputer in the ship operator's office ashore. The shipboard computer is used to generate maintenance schedules based on calendar days and by engine hours, update maintenance performed and add to machinery history, enter planned maintenance items, review regulatory body inspection schedules, and send/receive data to/from office. The shoreside computer is used to update regulatory body inspections, review maintenance performed, send/receive data to/from ship, and generate numerous reports useful to management.

Appraisal for the system thus far has been favorable. The system works well and has eliminated most of the time lag difficulties inherent in the "SMARS".

The complete final report is MARAD report number MA-RD-770-84025.

17. Document Analysis a. Descriptors

Logistics Support
Maintenance Management
Management Systems
Maintenance Programs
Maintenance
Merchant Ships
Spare Parts
Upkeep

b. Identifiers/Open-Ended Terms

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M & R (Maintenance & Repair)
Shipboard Maintenance and Repair System
Spare Parts Inventories

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EXECUTIVE SUMMARY

SHIPBOARD/SHORESIDE COMPUTER INFORMATION

AND

MANAGEMENT SYSTEM

PHASE II

CONTRACT NO. DT-MA-91-82-C-20001
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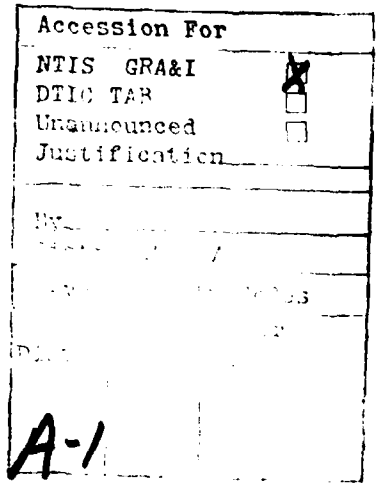

Prepared by

Pacific-Gulf Marine, Inc.

July 1984

Prepared for

U.S. DEPARTMENT OF TRANSPORTATION, MARITIME ADMINISTRATION

OFFICE OF ADVANCED SHIP OPERATIONS

PREFACE

This report covers Phase II of a two-phase project to develop and implement an integrated shipboard/shoreside computer information and management system for spare parts, preventive maintenance and machinery history aboard the M/V SUGAR ISLANDER and at the home office of the ship operator, Pacific-Gulf Marine, Inc. Phase I (MARAD Contract No. MA-80-SAC-01110 and Final Report No. MA-RD-930-83010) of the overall project dealt with inventory control, requisitioning, ordering, receiving and stowing spare parts for all major machinery aboard the SUGAR ISLANDER. Phase II of the project covers preventive maintenance based on calendar days, planned maintenance, regulatory body inspection schedules, repair maintenance based on engine hours, and machinery history. During Phase I of the project, a minicomputer was installed at the home office of Pacific-Gulf Marine. During Phase II, a minicomputer similar to the one at the home office was installed aboard the ship. With the completion of Phase II, the SHIPBOARD/SHORESIDE COMPUTER INFORMATION AND MANAGEMENT SYSTEM is fully operational.

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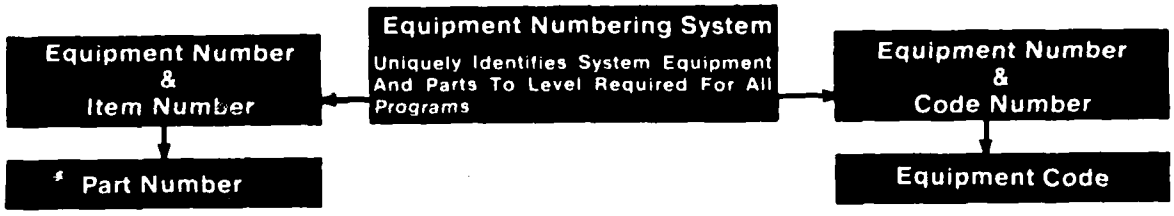
Shipboard/Shoreside Management System



Spares Inventory Control

1

Inventory Reports

- Print/Display/Edit Inventory Parts Usage & Name Plate Data Reports

System Maintenance

- Maintains File Data
- Backup & Restore
- Ship/Shore Data Transfer
- Yearend Processing

2

Requisition Processing

- Enter/Process/Print Requisitions
- Reduce Inventory Levels

3

Purchase Order Processing

- Enter/Process/Print Purchase Orders
- Retains Prices Paid

4

Material Receipts And Tag Printing

- Enter/Process Material Received & Print ID Tags

Maintenance & Machinery History

1

Preventative Maintenance

- Print/Display/Schedule Preventative Maintenance Actions

2

Planned Maintenance

- Print/Display/Schedule Shipyard Or Shoreside Repairs
- Maintains ABS & Regulatory Body Inspection Schedules

3

Repair Maintenance

- Print/Display/Schedule Change Out / Hourly Maintenance
- Enter Repair Reports

4

Machinery History

- Maintains Permanent File Of Pertinent Data From Other Programs
- Print/Display Machinery History

MASTER PLAN

BACKGROUND

PURPOSE

Pacific-Gulf Marine, Inc. and the Maritime Administration have jointly funded a research and development project aimed at solving shipboard inventory and maintenance control problems. The program design is such that Pacific-Gulf Marine, with the assistance of its subcontractors, are to develop, implement, demonstrate and evaluate an integrated shipboard/shoreside computer management information system in two phases as follows:

Phase I - Spare Parts Inventory Control And Ordering Programs
Phase II - Preventive Maintenance And Machinery History Programs

With the assistance of the Maritime Administration, the results of this project are being made available to other vessel operators for adaptation to their individual needs. The use of this integrated shipboard/shoreside system will increase vessel availability, lower maintenance and repair costs, minimize environmental risks and enhance the safety and productivity of operations and personnel. Widespread adoption of the integrated system by U.S. flag vessel operators could result in significant corporate profitability, increased personnel productivity, and marked improvement in the future competitive position of the U.S. Merchant Marine.

Effective spare parts management and inventory control will allow for the availability of spares for equipment requiring maintenance and at the same time, reduce onboard inventories and associated expenses. The system allows shipboard personnel to use and requisition spare parts while keeping associated booking chores to the barest minimum. Similarly, the system significantly reduces the manual effort required to write purchase orders in the office. Further savings accrue from reductions in time spent by shipboard personnel in determining the availability and stowage location of spare parts prior to performing maintenance actions.

BACKGROUND/HISTORY

In August 1973, the first U.S. flag vessel designed and built for unattended engineroom operation, the diesel-driven dry-bulk carrier M/V SUGAR ISLANDER was placed in service. As bareboat charterer and operator of this unique vessel, Pyramid Marine, Inc. of New Orleans, La. was faced with a number of new problems in shipboard organization and management. Among these was the development of a planned maintenance program to meet the requirements of U.S. Coast Guard Navigation and Vessel Inspection Circular No. 1-69. A preliminary maintenance program, developed by the vessel's Chief Engineer, was approved by the U.S. Coast Guard. However, it was recognized that the program did not provide a complete system for effective management of the total shipboard maintenance and repair effort. Upon learning of the Maritime Administration's program to develop a shipboard maintenance and repair system, Pyramid Marine, Inc. proposed to undertake direction of the effort to develop a basic system design and to provide and evaluate a diesel-plant prototype system. In July 1975, MARAD awarded a contract to Pyramid Marine, Inc. to begin work. The Stanwick Company, a division of The Stanwick Corporation, based in Norfolk, Virginia was engaged as a subcontractor to develop the basic system design and the diesel prototype system. TIMSCO, Inc. of Mobile, Alabama, was engaged to develop supporting computer programs, manage shoreside operation of the spare parts and machinery history subsystems, monitor system operation, and collect data during the evaluation. Pyramid Marine, Inc. was to exercise overall project management and provide the services of the M/V SUGAR ISLANDER as the evaluation vessel. In September 1976, Pacific-Gulf Marine, Inc. became the charterer and operator of the SUGAR ISLANDER and the contract was modified accordingly. The completed shipboard maintenance and repair system, known unofficially as "SMARS", was installed aboard the M/V SUGAR ISLANDER in August 1977. The system was evaluated during the period from August 1977 to March 1978, and the results of this evaluation were reported in MARAD Report No. MA-RD-920-78042 dated April 1978.

Although the Shipboard Maintenance And Repair System continued in use aboard the SUGAR ISLANDER and was enhanced through the introduction of preprinted requisition forms, it was recognized that the effectiveness of the system could be improved. One of the major factors influencing the effective operation of "SMARS" on the SUGAR ISLANDER was the substantial time lag between the acquisition and submittal of shipboard data and subsequent receipt of the updated automatic data processing printouts and replacement requisitions onboard the vessel. This time lag was primarily influenced by the length and nature of the vessel's trade routes coupled with the necessity of Pacific-Gulf Marine having to use an outside contractor to perform the automatic data

processing support functions. In many cases, this resulted in delays of several months in the availability of reliable and meaningful data to the vessel's engineers and to the shore staff. This delay in access to current spare parts and maintenance data was compounded by the frequent rotation of the vessel's engineers on vacation. As a result of these factors, the overall efficiency and reliability of the "SMARS" program was severely hampered and on occasions, resulted in expensive duplication of effort and purchases of spare parts. It became readily apparent that in order to function properly and obtain the maximum benefits from use of the shipboard maintenance/repair and spare parts inventory control system, up-to-date reliable data had to be made easily and readily available to both shipboard and shoreside office personnel on a continuous basis.

The most obvious solution to eliminating the time delay problems associated with the "SMARS" appeared to be conversion of the partially computerized "SMARS" into a fully computerized system utilizing one onboard minicomputer and another minicomputer at the vessel operator's office.

On September 29, 1980, a Proposal submitted to The Maritime Administration by Pacific-Gulf Marine became MARAD Contract #MA-80-SAC-1110 titled INTEGRATED SHIPBOARD/SHORESIDE COMPUTER INFORMATION AND MANAGEMENT SYSTEM FOR PREVENTIVE MAINTENANCE AND MACHINERY HISTORY AND INVENTORY/SPARE PARTS CONTROL AND ORDERING PROGRAM. The original contract covered only Phase I "Inventory/ Spare Parts Control and Ordering Program". The results of Phase I were reported in MARAD Report No. MA-RD-930-83010.

On March 23, 1982 MARAD Contract DT-MA-91-82-C-20001 was issued for the implementation of Phase II. The Phase II project was a joint effort of Pacific-Gulf Marine, Inc. (PGM), Trans-International Marine Services Corporation (TIMSCO) and Korkut Engineers, Inc.

TIMSCO was contracted by Pacific-Gulf Marine to assist in the preparation of the Preventive Maintenance and Machinery History Plan in accordance with guidelines set by the aforementioned contract and the specific needs of Pacific-Gulf Marine. Korkut Engineers was subcontracted by TIMSCO to provide computer programming for Phase II.

The computer hardware, Model HP250, was supplied by Hewlett Packard Company. The office computer was purchased during Phase I and the shipboard computer was purchased during Phase II.

The complete final report is MARAD report No. MA-RD-770-84025.

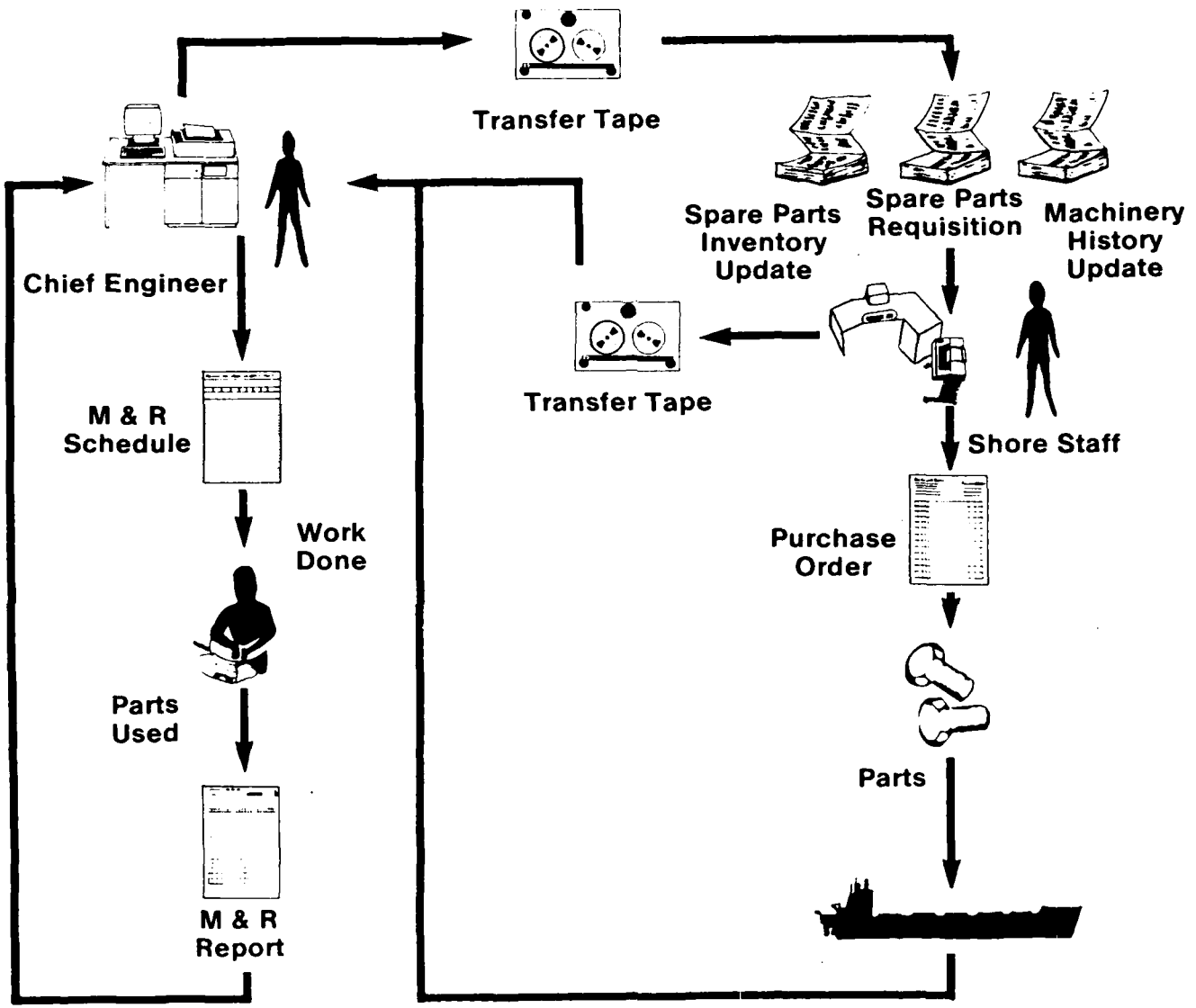
INTRODUCTION

SYSTEM PLAN

A system plan was prepared to guide the development of the overall SHIPBOARD/SHORESIDE COMPUTER INFORMATION AND MANAGEMENT SYSTEM. During Phase I, the emphasis and detail design was concerned with inventory/spare parts control, requisitioning procedures and purchasing functions. At the same time, an awareness of Phase II requirements (preventive maintenance and machinery history) was maintained to facilitate continuity of numbering systems, compatibility of forms, etc. The essential task during Phase I was to convert the manual aspects of the existing "SMARS" program into a computerized system. Additional tasks involved the review and careful consideration of all evaluations, comments, and criticisms accumulated since the implementation of the "SMARS" aboard the SUGAR ISLANDER; and an analysis of current and contemplated maintenance accounting requirements of Pacific-Gulf Marine, Inc. The integrated Phase I and Phase II system is diagrammatically represented on page 5.

The design philosophy and general requirements throughout the development of the entire system emphasized accuracy and timeliness in getting information to/from the ship. A prime consideration throughout was minimization of paperwork required from the ship's personnel. Specific objectives during Phase II of the project were to:

1. Eliminate the requirement for redundant entry of the same information.
2. Enable quick resume and display of failure or repair history of machinery.
3. Provide positive identification of machinery and its components.
4. Produce concise and timely reminders of anticipated preventive maintenance activity for each major component.
5. Provide simple procedures to record preventive maintenance activities just performed.



Shipboard/Shoreside Computer Information and Management System

MAJOR PROCEDURES

The Maintenance and Machinery History System accumulates machinery history data and provides a history for applicable equipment items in "calendar day" and "running hour" order. The consumption of spare parts for repair actions is reflected in the program. Regulatory body inspections are recorded and man hours consumed are noted. The program is very flexible and can be used to record many items of information relative to maintenance, repair and operation of equipment.

The HP250 computer based system includes the following major procedures:

CREATE MACHINERY HISTORY FILE - This history file is not to be purged, and correction of history information once entered requires authorization from a management level. The input to this file is from the repair work order report submitted by the Chief Engineer. It identifies the equipment, running hours, man hours required to repair, and the type and quantity of spares used.

MACHINERY HISTORY DATA ENTRY ROUTINE - An entry routine, tutorial in nature, will accept information contained in the repair work order report. The CRT display screen follows the actual hard copy repair work order format. Entry sequence is by the flashing cursor on the CRT. This routine will capture the equipment identification, running hours, textural failure information, preventive maintenance services rendered, and type and quantity of spares used.

PREVENTIVE MAINTENANCE SCHEDULE MATRIX FILE - The Preventive Maintenance Schedule tabulates equipment by functional category and time interval elapsed to perform inspection or preventive maintenance service. As maintenance is performed, schedules are updated.

LINKAGE TO SPARE PARTS INVENTORY SYSTEM - The data base management concept enables the data base to be shared between the Spare Parts Requisition/Purchase Order System and the Preventive Maintenance/Machinery History System. The data base design accounts for such linkage to enable the flow of information in either direction.

REPORTS - The Preventive Maintenance and Machinery History Program includes the following reports:

a. Preventive Maintenance Schedules by Calendar Days;
b. Repair Maintenance Schedules by Engine Hours;
c. Planned Maintenance Reports;

d. Machinery History Reports;
e. ABS Continuous Survey Reports; and
f. Regulatory Body Inspection Schedule Reports.

MAINTENANCE CATEGORIES

The Preventive Maintenance and Machinery History Program for the M/V SUGAR ISLANDER covers auxiliary equipment of the Deck and Engineering Departments as well as main propulsion equipment. Also covered is interior communications equipment, electrical equipment, navigation and automation equipment, galley and scullery equipment, and some but not all electronic equipment.

The Preventive Maintenance System provides guidelines (Maintenance Action Sheets) which show recommended maintenance actions and frequencies of those actions which, if performed on a regular basis, lead to longer equipment life and fewer breakdowns. Scheduling is included for all actions of a monthly or longer periodicity on a weekly basis by a computer printed Preventive Maintenance Schedule Form. The maintenance philosophy evolves around knowledge of equipment condition at all times rather than open and inspect routines to determine equipment condition. Preventive maintenance should be viewed as a means of extending equipment life which will lead to reduced costs over a period of time. Preventive maintenance is not a quick means of reducing costs and each individual ship operator must decide how much preventive maintenance is cost effective for his particular use.

The Equipment Numbering Identification System utilized in the earlier "SMARS" Program is retained with minor modifications.

The Planned Maintenance System includes the required data to maintain schedules for shipyard and shoreside repairs, ABS Continuous Survey, and Regulatory Body Inspections.

The Repair Maintenance System includes those items which will be directly recorded in the Machinery History System. The system includes programs to report repairs for entry to machinery history and a means for scheduling change-out items and parts required on an operational hours frequency. Scheduling of equipment preventive maintenance by equipment hours is also accomplished in this section. The purpose of including change-out items and preventive maintenance items scheduled by equipment hours is that these are items which seriously affect the vessel's operation and safety. They have come to be known as vital preventive maintenance whereas those listed in the Preventive Maintenance System described above are considered nonvital preventive maintenance.

The Machinery History System provides a means of recording all significant events concerning the ship's mechanical, electrical and electronic equipment. The system contains a ready means for researching any particular component by use of the equipment code. Regulatory Body Inspections and ABS Continuous Survey items may be recorded in the Machinery History System as they occur.

The entire system is designed so that only a minimum of time and effort is required by the operator in order to maintain the schedules. All schedules are updated by entering the completion date in the proper computer program with the exception of change-out items and items scheduled by operating hours. These are updated by entering the appropriate equipment operating hours. Proper programs for entry are identified by the forms used. In each part of the system, explicit instructions are included. The computer programs contain all necessary EDIT and ERROR checking routines to preclude ENTRY mistakes.

FINAL COMMENTS

SHIPBOARD HARDWARE PROBLEMS

During two years of computerized shipboard operation, only three problems were experienced that were hardware related.

PROBLEM 1 - During the first week of operation at sea, the computer aboard the SUGAR ISLANDER was out of operation for approximately two days due to equipment failures. The problem stemmed from loose circuit boards and two improperly secured ribbon cable wires within the central processing unit.

A modification was incorporated within the central processing unit to eliminate the circuit board problem. The modification included the gluing of a small strip of foam rubber padding to the back of the PCB board retaining brackets. With the retaining brackets in place, the foam rubber was between the retaining brackets and the edge of the PCB boards. This placed a small amount of pressure on the edge of each PCB board and prevented the boards from vibrating loose.

The two improperly secured ribbon cable wires originally had not been completely plugged in. The ribbon cables used in the HP250 have locking clips designed into the mating connectors. Once the cables were plugged in properly and the foam rubber backing was installed, the central processing unit functioned properly.

PROBLEM 2 - Approximately one month after installation, the hard disk drive failed. At the time of the failure, the vessel was positioned in the Persian Gulf area discharging cargo. No Hewlett Packard service facilities were in the vicinity so it was decided to delay repairs until the vessel's return to the United States.

Forty-five days later, upon return to Jacksonville, Florida, the problem was corrected by means of a ninety cent fuse. The Hewlett Packard representative discovered that the internal wiring schematic indicated that a 15 amp fuse was to be installed in the circuit but evidently the unit was shipped from the factory with a 10 amp fuse. The improperly sized fuse caused the computer to be out of service for 45 days. Once the correct fuse was installed, the hard disk drive functioned properly.

PROBLEM 3 - After 18 months subsequent to its installation, the display screen (CRT) failed. At the time of the failure, the vessel was discharging cargo in Mozambique but the closest service facility existed in Durban, South Africa.

The CRT was removed from the vessel and transported to Durban. The problem was apparently caused by a small piece of scrap metal inside the unit which caused several wires to short circuit. How the scrap metal entered the CRT remains a mystery. The equipment may have been shipped from the factory with the metal inside or the metal may have been inadvertently left within the CRT during installation aboard the ship or it may have rolled/bounced from the desk into the CRT vent port. Due to the logistics of transporting the CRT to and from the vessel between two African countries, the scrap metal caused the equipment to be out of service for three weeks. Once the metal was removed and the wires repaired, the CRT functioned properly.

OTHER SHIPBOARD RELATED PROBLEMS AND COMMENTS

The initial reaction to the computer on board was mixed; some of the engineers and mates were interested, and others did not want to get involved. The Chief Engineer and the First Assistant Engineer, the parties most involved in operation of the system, were interested and made several suggestions which they believed should be incorporated into the system. In general, their comments centered around changes to make the computer easier to use; i.e., making information easier to access. Their comments were evaluated and incorporated into the system. Also, as program "bugs" appeared at sea with no programmer onboard to fix the "bugs", the computer users became very frustrated and at times felt like throwing the computer overboard. After the "bugs" were worked out, system acceptance improved greatly.

At the first rotation of engineers after implementation of the system, indoctrination of the oncoming Chief Engineer for the Phase I programs was accomplished within eight hours with a very favorable reaction from the oncoming Chief. At a later date, indoctrination of the Phase II programs required an additional six hours. The Phase I spare part tag printing features of the onboard computer were highly praised by both Chief Engineers.

Some concern was expressed regarding dusty conditions which exist when the ship is loading/discharging grain and certain ores. To remedy this situation, the ventilation to the computer room is shut off and the door is kept closed when loading/discharging these types of cargo. A schedule has been established for periodic cleaning of the HP250 system hardware. Additional protection, including special filters for the computer room will be provided in the future if needed.

The initial rubber shock absorbing bushings used for mounting the central processing unit and disk drive assembly have functioned satisfactorily until now but have exhibited a need for improvement. The bushings could be improved to enhance their ability to absorb inertia loads from extremely heavy pounding which is sometimes experienced with the ship in ballast. A revised mounting system, incorporating shock/vibration isolators has been designed for a HP250 installation on a similarly sized vessel. After evaluation of this new mounting system, appropriate modifications may be made to the installation on the SUGAR ISLANDER.

RECOMMENDATIONS FOR FUTURE DEVELOPMENT

It has been suggested that the system should allow for economic order quantities for frequently used parts, and automatically reorder those parts at certain in-stock levels. It has also been suggested that in the future it may become cost effective to transmit inventory/ordering data between the shipboard and the shoreside computers by satellite, via modems.

With regards to the establishment of economic order quantities, Pacific-Gulf Marine does plan to establish such quantities after it has been firmly established what the yearly spare part usages are. Since the computer keeps track of yearly usage of all parts, the establishment of economic order quantities and an automatic reorder procedure may be forthcoming fairly soon. Only minor programming changes are anticipated to accomplish this task.

Pacific-Gulf Marine has always been interested in the possibility of data transmission to/from ship to shore via satellite. At the inception of the Phase I project, the technology to transfer data by satellite was in an embryonic stage, and satellite communication equipment was not installed aboard the SUGAR ISLANDER. For those reasons, data was transferred by floppy disk during Phase I and then by tape cartridge during Phase II. The data transfer procedure established for the project is satisfactory and works well. In the near future, Pacific-Gulf Marine may possibly be installing satellite communication equipment aboard the vessel. At that time, depending upon the stage of technological development for computer data transfer, it will be decided whether to modify the data transfer procedure to include satellite transfer or keep the procedure as it presently exists. An additional plus to satellite communication is that if software "bugs" develop while the vessel is at sea, it would be possible for a programmer ashore to correct those "bugs".

CONCLUSIONS

The Shipboard/Shoreside Computer Information and Management System using a computer onboard the M/V SUGAR ISLANDER and an in-office computer at Pacific-Gulf Marine has been in use for approximately two years. It is concluded that the program is a success and does meet the following Phase I and Phase II goals and objective as stated at the beginning of the project.

PHASE I OBJECTIVES

Allow the Ship's personnel to requisition spare parts while keeping associated bookkeeping chores to the barest minimum.

Assure accurate data transmission from ship to shore.

Allow positive identification of the spare parts delivered to the ship, which provides for inventory status update.

A further objective "Reduce capital investment in spare parts to the lowest degree possible" will be a gradual accomplishment. Any conclusion on this last objective will have to be made during a long term evaluation.

PHASE II OBJECTIVES

Eliminate the requirement for redundant entry of the same information.

Enable quick resume and display of failure or repair history of machinery.

Provide positive identification of machinery and its components.

Produce concise and timely reminders of anticipated preventive maintenance activity for each major component within the power plant on a periodic basis.

Provide simple procedures to record preventive maintenance activities just performed.

DOCUMENTATION

Documentation is available to enable individual operators to examine the complete SHIPBOARD/SHORESIDE COMPUTER INFORMATION AND MANAGEMENT SYSTEM in detail and to modify it to suit their particular needs.

Copies of the documentation are available from:

Pacific-Gulf Marine, Inc.
P. O. Box 6479
3010 General De Gaulle Drive - Suite 100
New Orleans, Louisiana 70114
Attention: Louis A. Marciello
(504) 362-8121

The documentation includes the System Operating Manual for both the Spares Inventory Control System (Phase I) and Maintenance and Machinery History System (Phase II). Source code copies of all computer programs, schema text files, data files and menus are available on either two 8 inch, 1.2MB, dual sided, double density floppy discs or one 150 foot tape cartridge. All programs, etc. are written in Hewlett Packard Basic language and operate on a Hewlett Packard Model 250 Computer.

In order to cover the cost of magnetic data storage material, data processing, printing and handling, a charge of seventy-five dollars is required.

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